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(54) **IC CARD**

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an IC card where a cover film is mounted on the both front surface and rear face and which is excellent in mass-productivity, difficult to be affected by the physical property of the cover film and is prevented from the occurrence of a deformation such as warping as much as possible.
SOLUTION: When cover films 3 and 4 superposed on the both sides of the surface and rear face of an intermediate sheet 2 made of a thermoplastic are pressurized while heated, the sheet 2 is fused so that a semiconductor chip 6 can be buried in the intermediate sheet and the films 3 and 4 are adhered to the sheet 2. The films 3 and 4 shrink in a cooling process after the fusion of the sheet 2. Because this shrinkage is specially large in the direction along the orientation axes of the films 3 and 4, an IC card is prevented from deforming as much as possible if the deviation of the orientation axes of the films 3 and 4 on the both surface and rear face sides is small.

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CLAIMS

[Claim(s)]

[Claim 1] The IC card characterized by for that orientation shaft to form the covering film of said table flesh-side both sides from the film of the almost same direction in the IC card equipped with the medium sheet made from plastics, the covering film made from plastics with which front flesh-side both sides of this medium sheet were equipped, and the semiconductor chip which was prepared in one covering film among both [these] covering films, and was embedded in said medium sheet while forming said medium sheet with thermoplastics.

[Claim 2] The covering film of said table flesh-side both sides is an IC card according to claim 1 characterized by a gap of an orientation shaft being 8 degrees or less.

[Claim 3] The covering film of said table flesh-side both sides is an IC card according to claim 1 or 2 characterized by being formed with the temperature more than a glass transition point with the ingredient with a low coefficient of linear expansion of 50 ppm or less.

[Claim 4] The elastic modulus of said medium sheet is an IC card according to claim 1 to 3 characterized by being twice [more than] the elastic modulus of said covering film.

[Claim 5] The IC card characterized by forming said medium sheet by reactant hot melt in the IC card equipped with the medium sheet made from plastics, the covering film made from plastics with which front flesh-side both sides of this medium sheet were equipped, and the semiconductor chip which was prepared in one covering film among both [these] covering films, and was embedded in said medium sheet.

[Claim 6] The covering film of said table flesh-side both sides is an IC card according to claim 1 to 5 characterized by a coefficient of linear expansion being almost the same.

[Claim 7] The covering film of said table flesh-side both sides is an IC card according to claim 1 to 6 characterized by thickness being almost the same.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the IC card of the three-tiered structure which comes to equip [a covering film] the front flesh-side both sides of the medium sheet equipped with the semiconductor chip which has functions, such as CPU.
[0002]
[Problem(s) to be Solved by the Invention] An ATM card, a credit card, etc. which are used widely now apply a magnetic stripe to a plastic card, and read the information recorded on this. In the thing of such a magnetic-recording method, there were problems, like there is little recordable amount of information for which information tends to be decoded by the third party.
[0003] Then, the IC card which mounted the semiconductor chip which has functions, such as memory and CPU, in the card-like base is developed, and it is already put in practical use in recent years. However, the problem that an IC card produces curvature, or produces a wave, and spoils an appearance with thin-shape-izing of an IC card by the physical properties of the film with which front flesh-side both sides are equipped for improvement in design nature, protection of a base, etc. is generated.
[0004] As what solves this problem, by the former, the hole was broken to one base plate made from plastics (about 0.5mm in thickness), the semiconductor chip was included in that hole, and the structure of sticking the film made from plastics of 0.lmm extent on front flesh-side both sides of that base plate through a binder layer was adopted. If this structure is used, by adopting a hard resin ingredient as a base plate, being influenced of the physical properties of the film of front flesh-side both sides is lost, and curvature and a wave can be lost. However, in the IC card of this structure, a hole is broken to a base plate and there is a problem of it being necessary to apply a binder to the front flesh-side both sides of a base plate, and to stick a covering film, and there being many routing counters, they being inferior to mass production nature, and leading to a cost rise.
[0005] This invention was made in view of the above-mentioned situation, and the object is excellent in mass production nature, and, moreover, it is hard to be influenced of the physical properties of the covering film with which front flesh-side both sides are equipped, and is in offering the IC card which can prevent producing deformation of curvature etc. as much as possible.
[0006]
[Means for Solving the Problem] In order to attain the above-mentioned object, invention of claim 1 is characterized by to have formed the medium sheet with thermoplastics, and the orientation shaft forming the covering film of front flesh-side both sides from the film of the almost same direction.
[0007] According to this configuration, since a medium sheet is thermoplastics, it will fuse, if it heats and an adhesive property is produced. Then, one covering film of the covering films of front flesh-side both sides is beforehand equipped with the semiconductor chip, a medium sheet is piled up on the covering film of one of these, the covering film of another side which remains on it further is piled up, and if it pressurizes heating them in this condition, the covering film of front flesh-side both sides will paste up a semiconductor chip on a medium sheet while it comes to be embedded in a medium sheet. For this reason, since adhesives are not applied to front flesh-side both sides of a

medium sheet but ** also ends while the hole for embedding a semiconductor chip on a medium sheet is broken beforehand and a dish ends, there are few routing counters and they become the thing excellent in mass production nature.
[0008] However, in what carried out heating fusion of the medium sheet in this way, pasted up the covering film on front flesh-side both sides of a medium sheet using the adhesive property, and was made into the three-tiered structure, the phenomenon (twist curl is called hereafter) of curving as were shown in drawing 7 and the IC card was twisted is generated. this invention person studied that the cause of generating of this twist curl was in a gap of the orientation shaft of the cover sheet of front flesh-side both sides. That is, a covering film is elongated in the heating process in which a covering film is pasted up on front flesh-side both sides of a medium sheet. And a covering film is contracted in a subsequent cooling process.
[0009] Telescopic motion of the covering film accompanying this heating and cooling is large especially towards meeting the orientation shaft which is the alignment (orientation) direction of a film molecule. For this reason, in order that a shrinkage force may act in the direction which is different on front flesh-side both sides when a covering film contracts by the above-mentioned cooling process if the orientation shaft orientation of the covering film of front flesh-side both sides is shifted greatly, twist curl occurs.
[0010] In invention of claim 1 of the above-mentioned configuration, since the orientation shaft formed the covering film of front flesh-side both sides from the film of the almost same direction, an IC card can prevent producing twist curl as much as possible.
[0011] In this case, as for a gap of the orientation shaft of the covering film of front flesh-side both sides, it is desirable like invention according to claim 2 that it is about 8 degrees or less. Thus, if it depends, even if an IC card produces twist curl, the deformation can be held down to 2 double less or equal of the thickness of an IC card.
[0012] Moreover, as for the covering film of front flesh-side both sides, it is desirable like invention according to claim 3 to be formed with the temperature more than a glass transition point with the ingredient with a low coefficient of linear expansion of 50 ppm or less.
[0013] If a covering film is formed with the ingredient of such a low coefficient of linear expansion, since the amount of telescopic motion accompanying heating and cooling will decrease, even if twist curl occurs, the extent can be stopped low.
[0014] Invention of claim 4 is characterized by making the elastic modulus of a medium sheet into twice [more than] the elastic modulus of a covering film. If it does in this way, deformation by contraction of a covering film can be controlled with the rigidity of a medium sheet, and extent of twist curl can be stopped low.
[0015] Invention of claim 5 is characterized by forming a medium sheet by reactant hot melt. Reactant hot melt consists of thermosetting resin, is fused at temperature lower than the glass transition point of a covering film, and presents an adhesive property. Generally, if a glass transition point is passed, a coefficient of linear expansion will rise, but if a medium sheet is formed by reactant hot melt, even if it will not heat plastic material till the glass transition point of a covering film, it can fuse a medium sheet. For this reason, the amount of telescopic motion of a covering film decreases, and twist curl of an IC card can be prevented as much as possible regardless of a gap of the orientation shaft of a covering film.

[0016] It is characterized by invention of claim 6 making the coefficient of linear expansion of the covering film of front flesh-side both sides almost the same, and invention of claim 7 is characterized by making thickness of the covering film of front flesh-side both sides almost the same. According to this configuration, since heating and the cooling conditions of the cover sheet of front flesh-side both sides become the same, the curvature and wave of an IC card can be controlled.
[0017]
[Embodiment of the Invention] Hereafter, one example of this invention is explained, referring to drawing 1 - drawing 6 . First, as shown in drawing 1 and drawing 2 , let IC card 1 be the three-tiered structure of the medium sheet 2 which functions as a medium glue line, and the cover sheets 3 and 4 with which front flesh-side both sides of this medium sheet 2 were equipped.
[0018] The cover sheets 3 and 4 of front flesh-side both sides become for example, polyester system plastics and a concrete target from the sheet made from PET (polyethylene terephthalate). one cover sheet 3 of the graphic display bottom is taken as a circuit sheet among both [these] the cover sheets 3 and 4 -- having -- that whole surface -- a conductor -- while the coiled form circuit pattern 5 as a circuit is formed, the semiconductor chip 6 connected to this circuit pattern 5 is mounted. And the semiconductor chip 6 is in the condition of having been embedded in the medium sheet 2, and is protected by the medium sheet 2.
[0019] In addition, in this example, the coiled form above-mentioned circuit pattern 5 is formed by the screen-stencil means which used the conductive paste, for example, a polyester system silver paste, and flip chip mounting of the semiconductor chip 6 is carried out by the anisotropic conductive adhesives 7. Although functioned as an antenna which transmits and receives an electric-wave signal, this circuit pattern 5 consists of a component which sends and receives a signal between external instruments, and this example so that power for actuation, such as CPU by which circuitry was carried out to the semiconductor chip 6, may also be obtained with the electric-wave signal from the external instrument received with this circuit pattern 5.
[0020] If said medium sheet 2 is heated, it will be in a melting condition and will consist of a sheet formed with plastic material with the thermofusion nature of being tinctured with a fluidity, for example, polyester system hot melt adhesive. This medium sheet 2 has the function to paste up self and cover sheets 3 and 4 while protecting the circuit pattern 5 and semiconductor chip 6 grade, and is a wrap without a clearance about the circuit pattern 5 and semiconductor chip 6 grade. Moreover, the cover sheets 3 and 4 of front flesh-side both sides perform design-printing besides [which protects the comparatively elastic medium sheet 2] a function, and have the function of raising the appearance design of IC card 1.
[0021] Here, if the thickness of the medium sheet 2 and cover sheets 3 and 4 is described, it is set as 0.1mm with the covering films 3 and 4 of 0.3mm front flesh-side both sides respectively same [the thickness of the thickest medium sheet 2], and thickness has become 0.5mm as the IC card 1 whole.
[0022] In order to manufacture IC card 1 of such a three-tiered structure, a semiconductor chip 6 is mounted in the cover sheet 4 which is one side first. Then, thermocompression bonding is carried out with the heat press equipment with which the medium sheet 2 and the cover sheet 3 of another side are piled up in order on a cover sheet 4, and while the

semiconductor chip 6 was mounted does not illustrate the whole. Then, the hot melt adhesive which changed into the melting condition in order to heat the hot melt adhesive which constitutes the medium sheet 2, to fuse and to be tinctured with a fluidity is a wrap without a clearance about the circuit pattern 5 or a semiconductor chip 6. Simultaneously, the medium sheet 2 is fabricated so that thickness may become uniform by application of pressure from vertical both sides, and it pastes up cover sheets 3 and 4 with the adhesive property.

[0023] Whenever [in this heating process / stoving temperature] is about 140 degrees C higher than the melting temperature of the medium sheet 2, and this temperature is higher than the glass transition point (70-80 degrees C) of the covering films 3 and 4. And the medium sheet 2 is solidified and IC card 1 of a three-tiered structure which consists of a medium sheet 2 and cover sheets 3 and 4 of the front flesh-side both sides by the above is manufactured by subsequent cooling.

[0024] Thus, in equipping the front flesh-side both sides of the medium sheet 2 with cover sheets 3 and 4, even if it does not form beforehand the hole for embedding a semiconductor chip 6 on the medium sheet 2 since the medium sheet 2 was formed with hot melt adhesive, a binder is not applied to front flesh-side both sides of the medium sheet 2, but ** also ends. For this reason, there are few routing counters and they are excellent in mass production nature.

[0025] Now, said cover sheets 3 and 4 are formed from the film material 8 extended in the biaxial direction (arrow heads A and B show) in which length and width intersect perpendicularly, as shown in drawing 5 . If this film material 8 is extended by a lengthwise direction and the longitudinal direction at a certain rate, respectively, a film molecule will align in the synthetic direction of that lengthwise direction and longitudinal direction (orientation). Although alignment of this film molecule is called orientation shaft, if that orientation shaft orientation has the the same location of the cross direction (arrow head B) of a film material 8, it will turn into the almost same direction also in the location of the die-length direction (arrow head A) throat. Several m and since it is very broad, this film material 8 by which the biaxial drawing was carried out cuts this in width of face of about 50cm, and usually rolls it round in the shape of a roll.

[0026] Drawing 4 shows the result of having measured the orientation shaft orientation of each part of the cross direction of the 4m piece film material 8. In this drawing, an axis of abscissa shows the location of the cross direction of a film material 8, and the axis of ordinate shows orientation shaft orientation. Here, the location of the cross direction of a film material 8 was expressed with the clearance from the core of the cross direction of a film material 8, set the crosswise core to "0", rightward the distance from the center position was attached, and plus (+) and leftward attached the sign of (-), and showed it. Moreover, orientation shaft orientation was expressed with the include angle with the straight line along a lengthwise direction (the die-length direction of a film material 8) to make, made the straight line along a lengthwise direction "0 degree", and attached and showed [inclination / by brass (+) and the counterclockwise rotation] the sign of (-) about the inclination by the clockwise rotation from the 0-degree straight line.

[0027] Although the orientation shaft of a film material 8 differs from about 80 degrees greatly by part for about 25 degrees and a right edge, and the left end part in a part for a crosswise center section, and a part for a right edge and a left end part so that I may be understood from this drawing 4 About the film materials (a roll-like film material is

called hereafter) 9a-9h which were cut from the film material 8 by 50cm width of face, and were rolled round in the shape of a roll, if it is in the same roll film ingredient, it is 5-6 degrees or less.

[0028] In this example, and the covering films 3 and 4 of front flesh-side both sides So that it may judge from the same roll film ingredient among the roll film ingredients 9a-9h and the inclination direction of an orientation shaft may turn into the same direction Namely, if the front face in case one covering film 4 is a roll film ingredient was made into the adhesion side with the medium sheet 2 If the covering film 3 of another side made the rear face at the time of a roll film ingredient the adhesion side with the medium sheet 2 and the rear face in case one covering film 4 is a roll film ingredient was made reverse in the adhesion side with the medium sheet 2 The covering film 3 of another side makes the front face at the time of a roll film ingredient an adhesion side with the medium sheet 2. Consequently, it means that the covering films 3 and 4 of front flesh-side both sides will be in the condition that orientation shaft orientation (theta shows to drawing 6) was arranged in the almost same direction, and the amount of gaps of the orientation shaft of both the covering films 3 and 4 was restricted to 5-6 degrees or less as shown in drawing 7 .

[0029] Drawing 3 shows the result of having changed various the amounts of gaps of the orientation shaft of the covering films 3 and 4 of front flesh-side both sides, and having measured the amount of twist curl of IC card 1. Here, when IC card 1 is placed on a flat surface by experience, it is supposed that it is dependent on whether the maximum height of IC card 1 is twice [more than] the thickness whether it is sensed that the appearance of IC card 1 is spoiled. In addition, the amount of twist curl is expressed with the height dimension from the flat surface to the highest part of the top faces of IC card 1 when IC card 1 is placed on a flat surface.

[0030] And when the amount of gaps of the orientation shaft of the covering films 3 and 4 of front flesh-side both sides was 8 degrees or less so that clearly from drawing 3 , the amount of twist curl did not deform, so that the greatest thing also spoiled the appearance by about 1mm at about 2 times of the thickness (0.5mm) of IC card 1. However, if the amount of gaps of the orientation shaft of the covering films 3 and 4 of front flesh-side both sides becomes about 10 degrees, in the biggest IC card of the amount of twist curl, it will be set to about 2mm and an appearance will be spoiled.

[0031] From this experimental result, it can be said on twist curl prevention that it is desirable to hold down to 8 degrees or less as for the amount of gaps of the orientation shaft of the covering films 3 and 4 of front flesh-side both sides. And in this example, since the amount of gaps of the orientation shaft of the covering films 3 and 4 of front flesh-side both sides is restricted to 5-6 degrees or less, it can hold down the amount of twist curl to 2 double less or equal of the thickness of IC card 1, and does not spoil an appearance.

[0032] Since the covering films 3 and 4 of front flesh-side both sides are especially obtained from the same roll film ingredient by this example, the coefficient of linear expansion of both the covering films 3 and 4 is the same, and the thickness is also the same. Since the coefficient of linear expansion is the same, the amount of telescopic motion of both the covering films 3 and 4 becomes comparable, and the curvature of IC card 1 to which it comes from the amount of telescopic motion of one covering film being larger than that of the covering film of another side can be prevented as much as

possible. Moreover, since the thickness of both the covering films 3 and 4 is the same, the shrinkage force given to the medium sheet 2 by contraction becomes the same about the front flesh-side both sides of the medium sheet 2, and both the covering films 3 and 4 can prevent the curvature of IC card 1 resulting from the difference of the flexible force which the covering films 3 and 4 of front flesh-side both sides give as much as possible.

[0033] In addition, this invention is not limited to the example which describes above and is shown in a drawing, and following modification or escapes are possible for it. The covering films 3 and 4 of front flesh-side both sides may be the things of different construction material and different thickness. the elastic modulus of the medium sheet 2 -- it of the covering films 3 and 4 -- a certain thing is desirable more than twice. If it does in this way, since the flexural strength-proof of the medium sheet 2 will become large, the medium sheet 2 can prevent the curvature at the time of a carrier beam for a shrinkage force as much as possible to the front flesh-side both sides by contraction of the covering films 3 and 4.

[0034] Generally, the coefficient of linear expansion of plastic material will become large suddenly, if a glass transition point is exceeded. Whenever [for pasting up the covering films 3 and 4 on the medium sheet 2 / stoving temperature] usually exceeds the glass transition point of the covering films 3 and 4. On the other hand, it depends for the amount of twist curl of IC card 1 on the size of the amount of telescopic motion of the covering films 3 and 4. For this reason, in order to suppress twist curl, even if the covering films 3 and 4 serve as temperature more than a glass transition point, it is desirable [the films] to form from plastic material with a low coefficient of linear expansion. Specifically, it is good to form the covering films 3 and 4 also at the temperature more than a glass transition point from a brass tic ingredient with a low coefficient of linear expansion of 50 ppm or less.

[0035] You may make it form the medium sheet 2 by reactant hot melt. Reactant hot melt consists of thermosetting resin, is fused at temperature (for example, 60 degrees C) lower than the glass transition point (70-80 degrees C) of the covering films 3 and 4, and presents an adhesive property. Therefore, if the medium sheet 2 is formed from reactant hot melt, even if it will not heat till the glass transition point of the covering films 3 and 4, the medium sheet 2 will be changed into a melting condition, and the covering films 3 and 4 can be pasted up. For this reason, the covering films 3 and 4 can be pasted up on front flesh-side both sides of the medium sheet 2 at the temperature below the glass transition point when the coefficient of linear expansion of the covering films 3 and 4 is small, and since the amount of telescopic motion of the covering films 3 and 4 in this case is small, regardless of a gap of the orientation shaft of the covering films 3 and 4, twist curl of IC card 1 can be prevented as much as possible.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The sectional view of the IC card in which one example of this invention is shown

[Drawing 2] The decomposition perspective view of an IC card

[Drawing 3] Measurement drawing showing the relation between a gap of the orientation shaft of a front **** covering film, and twist curl
[Drawing 4] Measurement drawing showing the inclination of the orientation shaft of each part of the film material which carried out the biaxial drawing
[Drawing 5] The perspective view of the film material which carried out the biaxial drawing
[Drawing 6] The perspective view showing the orientation shaft orientation of a front **** covering film
[Drawing 7] The perspective view showing twist curl
[Description of Notations]
As for a medium sheet, and 3 and 4, for one, an IC card and 2 are [a cover sheet and 6] semiconductor chips among drawing.